

J. P. Gray
REPORT

May 1850.

ON THE

GENERAL PRINCIPLES

TO BE ADOPTED FOR THE IMPROVEMENT OF THE NAVIGATION

OF THE

RIVER SAINT JOHN,

FROM THE

GRAND FALLS TO FREDERICTON,

BY

CAPT. BENT, Royal Engineers, and Mr. GRANT, Civil Engineer.



Laid before the House of Assembly by command of His Excellency the Lieutenant Governor, and ordered to be Printed 4th March, 1850.

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1850.

REPORT.

Fredericton, 12th November, 1849.

SIR,—In pursuance of the instructions of Your Excellency, dated 27th July last, we have the honor to submit our Report on the general principles which, in our opinion, should guide the Provincial authorities in carrying into effect the appropriation of the Grant of £10,000, voted for the improvement of the Navigation of the Saint John River, between the Grand Falls and Fredericton.

We have confined our attention to the consideration of the most economical and effectual method of rendering the River navigable for Steamboats of small draught during the Summer season.

It is found that a boat going with full speed in a narrow channel, up a rapid, will generally require from ten to twelve inches more water than she draws at other times; we have, therefore, fixed 3' 6" as the minimum depth requisite in such localities, and 3 feet in the moderately swift.

There was less water in the River at the time we took the soundings over the Bars and Shoals, (August 1849,) than during average years; but in seasons of great draught the flow of water is considerably reduced. On comparing the results of our inquiries, we have assumed a probable level below which it rarely falls, viz., when there is only 1' 10" found over Bear Island Bar, and reduced the other depths accordingly. As the operations proposed tend, in almost every instance, to lengthen the course of the channel where the water is rapid, by deflecting it from one side of the River to the other, the average velocity of the current will be lessened, and, as experience has established, that at no one locality is the ascent too rapid for the passage upwards of boats, we have in most cases omitted taking the difference of level of the water at the top and bottom of the several obstructions, and assumed as correct the dimensions given in the printed Table which accompanied the Report of Mr. Foulis, D. P. S., dated 21st August, 1826, having no reason to doubt the accuracy of his Surveys. The period for our operations being limited to the few weeks when the level of the water is lowest in the River, and to one season only, we were necessitated to make our examination in too rapid a manner to enable us to observe the quantity and kind of detritus accumulated

at any particular spot, or to obtain an accurate knowledge of the stability of the River's bed, as determined by the nature of the soil, the tendency to erosion of the banks, the impinging force of the stream, and velocity of the current.

Finding it an easier task, when following the downward course of the River, to describe the effects produced by its action, and the Shoals formed by its deposits, than when an observer is proceeding upwards, we propose to report on the several obstructions as they occur in succession from the Grand Falls to the deep water above Fredericton; many of the Rapids and Shoals have several names, but we have adopted such as appeared best known to the boatmen, and persons frequenting the River.

From the deep water in the Basin, at the foot of the Grand Falls, to Cuffeman's Bar, a distance of about 40 miles, the general characteristic of the River is, that it flows between high sloping banks, and is divided into a series of pools, or reaches, sometimes by natural dams, where ledges of rock extend across the bed of the River; at others, its course is blocked up, and the space through which it discharges lessened by numerous reefs, and detached masses of rock; and again, by the contraction of the opening between the banks. The pools so formed contain comparatively still, deep water, except where a rapid is created by the stream flowing over the top of the natural dams, or escaping through narrow passages in these barriers. Shoals are formed above and below these obstructions, according to local circumstances, and the set of the current during the period the floating ice is in motion. The remedies to be applied to procure a safe channel through such obstructions, are either to contract still more the opening of discharge, or to straighten the course, and widen it by the removal of some of the smaller masses of rock, taking care, when recourse is had to the former expedient, that the position of the dams or works are not liable to be carried away by the ice, and when to the latter, that the general level of the water way is not materially reduced.

WHITE RAPIDS.—*Survey No. 1.*

The first of these natural dams at which any obstruction to the navigation occurs, is about $1\frac{1}{2}$ miles below the Grand Falls, and is called the "White Rapids," where the bed of the River is crossed by several reefs of stratified rock, causing broken water for above 1,000 yards in extent. The boat channel is close to the right bank, its depth varying from 2' 6" to 6 feet; the projecting ledges of the reef are broken and disconnected, so that the water discharges freely through them, without sufficient restraint—flowing too generally over its wide rocky bed throughout the entire breadth of

the stream. The remedy to be applied is, in the first instance, to clear a straight channel for boats through the rocks, and then to so regulate the space over which the water flows, that enough be diverted to ensure a depth not less than 3' 6" for the passage of boats at all seasons; we therefore propose to remove, by blasting, the two small rocks, A and B, and to fill up with sunken crib-work and stones the openings through the ledges of rock CD EF; the probable expense of these services would be £500.

The banks of the River above and below the "White Rapids" are high gravel slopes; they were covered until of late years with trees and vegetation, but in the endeavour to form a tow path along the right bank, a deep notch was cut into the foot of the slope, which permitting the water and frost to act on the lower strata, have by their erosion undermined and caused the surface of the upper portion to slide down into the River; this damage is increasing rapidly, and will continue until the slip has embraced an extent of more than a mile above the rapids; nor does any remedy suggest itself without the expenditure of a large sum of money in the construction of a new tow path, having its cutting supported by plank, or some other material; for it is presumed a horse track must exist so long as boats have to be towed past this locality. The quantity of gravel thus conveyed into the bed of the River every year, is not, however, so serious an evil as would appear at first sight, for the current runs so strong as not to permit it to remain immediately where it falls, and carries it forward to be deposited in the bed below the White Rapids, and may be considered to have there the beneficial effect of contracting the width of the waterway between the rapid last referred to and the rapid "Des Femmes," and thus confining the stream within a narrower and consequently deeper channel.

LITTLE RIVER RAPID.—*Survey No. 2.*

The water continues strong and broken, but the channel has a good average depth, and is free from any serious obstructions down to the mouth of the "Little River," from whence, and extending down more than a mile, the bed is studded with numerous rocks and reefs, through which sufficiently deep but crooked channels wind; that which is considered the best for the passage of Steam Boats, is shown dotted on Plan; but as the current sets strongly across the stream from left to right, they are in danger, after passing rock A, of being carried against reef B, and again passing clear of C, of striking on D; also when avoiding E, of striking on F, or even clearing the latter, called "Split Rock," a greater danger is to be apprehended of stranding on the long reef G. A is an isolated cube of rock standing in 4 feet water, and if removed, a

Boat would have a better chance of obtaining a good position to make a clear passage through the lower intricate reefs; the River at this place averages 220 yards wide, and a sufficiently deep channel obtains only in consequence of its bed being contracted by the numerous rocks and reefs alluded to; we therefore consider it to be inexpedient to remove or blast any of them, except that marked A, and in lieu thereof, propose to construct a work against the ledge of rocks H I, projecting from the right bank, in order to dam back the waters, and deaden the strength of the current through the tortuous position of the passage. This work will average 9 feet high and 70 yards in length, at a probable cost of £310.

ARESTOOK BAR.—*Survey No. 3.*

The water way of the Saint John is contracted above its confluence with the Arestook by ledges of stratified rock, sloping into its bed from the left bank, confining the channel to narrow limits, and causing a depth of water exceeding 10 feet, but as it disappears again from the bed of the River, and allows the water a free discharge, the greatest depth that occurs during seasons of ordinary dryness, is 2' 9"; this reduction is also to be attributed to a shoal of stones and gravel deposited where the current of the Arestook loses its transporting power on joining the less rapid water of the Saint John. It therefore seems to us evident, that in order to ensure a sufficiently deep channel over this bar, some artificial means must be resorted to to arrest the flow of the water over too great a surface, and at the same time cause a stronger current at this spot to clear a deeper channel through the gravel shoal stated to have accumulated there. For this object we propose to throw out the Dam shewn in Plan No. 3, from the left bank, bending down the stream, to be constructed of cribwork, and loaded with stone, its average height to be 5 feet, length 170 yards, and probable cost £280.

TOBIQUE RAPIDS.—*Survey No. 4.*

The natural dam across the Saint John at the confluence of the Tobique River, is composed of a mass of stratified rock, extending obliquely across its bed from the left to the right; elevated ledges of this reef appear above the surface of the water, sometimes on one side of the river, and sometimes on the other; thus the water escapes too generally over the wide space between the banks, to allow a partial collection of a sufficient body in any one channel. The right channel is through narrow openings in the ledges, with comparatively deep water; but these ledges are passed in quick succession, and the breaks through them not being opposite to each other, the course is too tortuous to be rendered a safe channel for boats in the rapid water; for this reason, the channel most used

is the one following the left bank, past the Indian Village, to the embouchure of the Tobique, thence following the current across the Saint John, where it runs swiftly through the principal ledges which show above the surface, pass into the deep water channel to the right of the large isolated rock in the middle of the River. From the head of the shoal to its foot, a distance of 900 yards, the River falls 4' 8½". The soundings past the Indian Village vary from 1' 6" to 3' 0", the depth at the mouth of the Tobique is 6 feet passing into 4 feet, 3 feet and 2 feet in succession, and then deepens quickly to 6 feet and upwards. The draught of water is evidently down the right channel, and should be maintained, if it was not for the dangerous passage through the reefs. In order to divert the stream from the right to the left, dams must be so constructed as entirely to change the direction of the current, until after passing the rocks called the "Devil and Indian;" three in all probability, will be required :—

A B 233 yards long, to raise the water on the head of the bar.

C D 140 yards long, to stop the flow through an elevated reef of rocks, in order to dam back the water over the foot of the bar and confine its flow to narrower limits,—and

E F 100 yards long, to act in conjunction with C D and destroy the natural tendency of the stream to revert to its original course after passing an impediment placed across it.

The expense of these services will be about £1,330

TOBIQUE ROCKS.

A number of large masses of rock stand in the stream about 4 miles below the Tobique River, known as the "Tobique Rocks," one of these, situate in the channel, and nearly opposite to Lally's Creek, should be removed; probable cost £5.

BISHOP'S & IMMAUN'S ROCKS.

"Bishop's Rocks," and "Immaun's Rocks," further down the River, interrupt its free navigation, but a wide and sufficiently deep channel is found between them.

KILBURN'S RAPID.

About 1 mile above the "Muniac River," a natural dam of solid ledges of rock, extends directly across the bed of the River, over which the water runs; two passages through it afford straight channels for boats, with 4' 6" water.

MUNIAK BAR.

There is a shoal off the mouth of the Muniac River, the water 4 feet deep, also a reef of rocks across the Saint John, but this latter should be no obstruction if the Pilot knows the River.

FITZHERBERT'S RAPIDS.—*Survey No. 5.*

The impediment to the navigation between the Great and Little Aquisquit River, is caused by the combined influence of an increased declivity in the bed of the River, by the course of the stream being crossed obliquely by discontinuous ledges of stratified rock, and by the interspersing of large erratic blocks of stone. Through the broken water in this locality, known as "Fitzherbert's Rapids," there are three boat channels, which diverge from each other to avoid particular rocks; but in every case, the boats must pass close to the reef of rocks marked K, where the depth varies from 2' 9" to 3' 3", with a hard rocky bottom; then avoiding several sharp reefs, some sunken, others barely visible, the only passage is through the deep strong water between the reef No. 8 and the rock No. 9; this latter rock, which is most in the way, (from the set of the current,) is an erratic block, 2 feet below the surface, and can easily be removed by blasting; the other ledges, standing in deep strong water, and whose strata are nearly vertical, cannot readily be blasted, so that any attempt to form a strait channel, or lower the bed of the River to the right or left of K, could not be undertaken with any prospect of success; the most simple remedy that offers, is to contract the space through which the water discharges in order to raise its level in the channels among the rocks; we therefore propose to stop the flow through the reef No. 2, by the construction against it of a dam from the left bank, projecting 150 yards into the stream; its average height will be 5 feet; a good channel may then confidently be expected by following the track marked on Plan A B C D; and probable cost together with removal of the rock, £250.

KELLY'S ROCKS.

Below the Aquisquit River, one of the rocks called "Kelly's Rocks," might be removed in the course of the operations to improve the navigation.

POMFREY'S ROCKS.

Some rocks pointed out as "Pomfrey's Rocks," cause broken water, but do not appear to obstruct the channel.

CUFFEMAN'S BAR.—*Survey No. 6.*

The last of the natural dams at which an obstruction to the navigation occurs, is about 1 mile below Hardwood Creek, and called "Cuffeman's Bar," it consists of ledges of rocks running partially across the bed of the River, together with a shoal of stones and gravel deposited against and below it.

The water in its passage spreads once nearly the whole width of the River from bank to bank, but its discharge is deepest—

First, in a narrow channel past the extremity of the main ledge of rocks extending from the right bank : Second, through the same ledge close to the right bank : Third, by a channel down the middle of the River, passing over the head of the bar into the deep water below the main ledge of rocks : Fourth, by another channel crossing from the left bank obliquely across the bar into the deep water below the main ledge of rocks.

The set and force of the current is towards the right bank, against which the ice packs in the Spring.

The water in the first channel is deep, with soundings from 5 to 10 feet, passing again into 5 and 6 feet. A skilful and well practised pilot could run a small boat down this channel at any time ; but during seasons of low water it is an extremely dangerous one, being in the vicinity of sharp projecting rocks, against which boats, after passing round the end of the extreme ledge, are liable to be drifted by the eddies, as well as by the set of the current.

The second channel could be rendered of sufficient width and depth, by blasting off the top of some of the projecting ledges ; but from the nature of the formation of these rocks, it would be difficult to blow them without the danger of jagged projecting points being left, and of boats striking against them should they swerve at all from the direct channel in this rapid water.

The third or centre channel is the most direct and straight, it crosses the head of the shoal in 2' 9" water, and where the bed is comparatively smooth.

Where the 4th or left channel crosses the shoal, the depth of water varies from 2' 3" to 3' 0".

Both these two last could be deepened, but from the wide expanse of the water, and the quantity of gravel brought down by the floods in the Spring, any excavation would be extremely liable to be quickly filled up ; under these circumstances, we have selected the third or centre channel for improvement, and which we propose to effect by means of a wing dam, projecting from the left bank, to bend obliquely 160 yards down with the stream, in order, by contracting the width of the water-way of the River, to turn a greater volume into the channel in question.

After the execution of this work any alteration in the extent and position of the shoal must be carefully watched, in order that an addition or reduction be made to the length of the dam, according to the form assumed by the accumulating gravel and debris. The probable cost will be £180.

MONQUART RIVER.

There is a small rock in the channel, at the mouth of the Monquart River, which should be removed. Probable cost, £5.

SQUIRE'S BAR.

About 1½ miles below the Monquart River a shoal caused by the ice jamming against the left bank, composed of rounded stones and coarse gravel, extends across the River; the depth of water in the centre channel is rarely less than 3 feet; this shoal, known as "Squire's Bar," is not considered a sufficient impediment to the navigation to require immediate attention.

CHICKTEHAUK STREAM.

There are two rocks standing in the channel, about 250 yards above the mouth of the Chicktehawk Stream, which should be removed. Probable cost, £10.

GREEN ISLAND.—*Survey No. 7.*

Green Island divides the River into two branches: that on the left is interrupted by numerous shoals, whilst a good boat channel is found down the right one, with deep water to where it cuts through a bar extending across the River. Its depth then varies from 2 feet to 2' 6" only. This bar appears to be an accumulation of the stones and gravel deposited above, and against the ice, which in the Spring of the year, after jamming below at a sudden and narrow bend of the River, packs back in a solid mass to the foot of the Island.

The current in the Summer sets from the Island to the right bank, and is again deflected towards the middle of the River, to where the deepest water is found over the bar. In order to throw a greater volume of water into the same passage, we propose the construction of a wing dam, AB, to project from the right bank 180 yards obliquely down with the stream, and which, from its position and inclination, will not be liable to be injured by the floating ice; and further recommend the construction of the embankment CD. 270 yards long, bending down with the stream, to stop the spread of the water over the sunken portion of the foot of the Island. The probable cost will be £510.

CHARACTERISTIC OF THE RIVER.

The characteristic of the River exhibits entirely new features throughout the section we have now to describe; the banks in many places rising in successive steps or terraces, from one level surface to another, evince that the bed of the River stood formerly at a much higher level than it does at present; appearances denote elsewhere that the wide basins through which the River flows contained a chain of lakes which spread through the valley of the Saint John, during the period the water stood at a higher level. There is in many localities seen the trace of channels the stream has of late years cut for itself through the alluvial deposit which then took

place, (now called "Intervalles"); in some places forming Islands, and at others, where the current sets against it, washing it down, until the sunken remains assume the appearance of shoals in the course of accumulation. Several bars and shoals are thus formed between Green Island and the Beckaguimec River; the principal of which are—

Wakefield Bar ;

Palmer's Island Shoal ; and

Presqu'île Island Shoal ; but which are not at present serious impediments to the navigation, and have not therefore been made the subject of special notice.

BECKAGUIMEC BAR.—*Survey No. 8.*

The boat channel then follows the left bank of the River, with deep water, past Presqu'île Island and Beckaguimec Island, where it cuts a passage for itself through a bar, which extends nearly across the River, the depth of water varying from 2' to 2' 6"; this bar is the sunken portion of the foot of Beckaguimec Island, and of the flat land or intervalle seen along the left bank, over the remains of which the water now flows, the action of the current having gradually washed away the upper strata of the soil, with the vegetation that grew thereon. The main body of the water now flows between Beckaguimec Island and the left bank, and can be conducted in sufficient volume over the bar if its spread is stopped by the construction of an embankment, AB, on the sunken portion of the Island, and extending about 400 yards down the River ; care must be taken that the dam terminates *precisely* at the spot where the strength of the current disperses down the main body of the stream. The bed of the River at the obstruction is composed of hard coarse gravel, over which the current runs too strong for any accumulation to take place of the moving gravel and sand. Should this work prove insufficient, a dam, CD, should be constructed between Beckaguimec and the Island above it, to stop the flow of water in the passage between them. The probable cost will be £370 for the dam AB.

CAMPBELL'S ISLAND.

There is shoal water at the head of Campbell's Island, called "Potts' Rapid," but no difficulty is experienced to the passage of boats during ordinary seasons of low water ; the extent and position of the accumulation of gravel and stones should be watched, and if any obstruction to the navigation be experienced hereafter, a wing dam should probably be constructed at the bend, in order that the body of the stream which is now drawn among the rocks in the

cove in the right, may be directed to throw a greater volume into the left channel, and to cause the current to set against the head of the shoal, and excavate for itself a deeper water-way through the loose soil. There is deep water the entire length of the Island, and without any obstructions to the free navigation until after passing round its foot, when the channel takes so sudden a turn it is difficult for the boats to avoid striking on some rocks near the left bank; five or six of these can be easily removed and dragged on shore, at a cost not exceeding £20.

GRAND BAR.—*Survey No. 9.*

Seven miles from Woodstock the River divides into two channels to the right and left of a half sunken Island, $1\frac{1}{4}$ miles in length, called the "Grand Bar;" the channel on the right is contracted and rendered dangerous for the passage of large boats by reefs of rocks, which project into its bed; that on the left is the one generally used; has a comparatively smooth bed, formed of coarse gravel, with deep water until it crosses the foot of the bar. This section of the River exhibits most unequivocal traces that its stream has cut its course through an alluvial deposit; from the form, &c., it seems probable that the oldest and only water-way was the channel on the right, at which period the Island (or bar) formed a tract of intervale along the left bank, remnants of which are still visible at A and B. It does not appear that any new deposit takes place at this bar; the current is rapid, without eddies, and sufficiently strong to carry forward any stones and gravel transported hither by the stream; the depth of water where the channel crosses the bar is thought by the pilots to be less than formerly; but this seems to be the effect of the water spreading over a wider space by the gradual erosion of the more elevated portions of the foot of the Island; under such circumstances the remedy to be applied is to endeavour again to contract the water of the River where it is shoalest, and which it is considered can be effected in the readiest way by a dam from the left bank, opposite the foot of the Island, stretching obliquely 500 yards with the stream, towards the right bank; also to weather the foot of the Island with a protecting embankment. Should this prove insufficient, the flow down the right channel, at low water, should be stopped by a dam across it from the head of the Island, GH. The probable cost of the dam, CD, and embankment, EF, will be £140.

DIBBLEE'S BAR.—*Survey No. 10.*

The appearance of the country for 3 miles below Woodstock, betokens most undeniably, that the stream is continually cutting passages for itself through the alluvial deposit of one of the chain of Lakes which at a former epoch existed; one of these passages

has separated Fraser's Island from the main Land ; this Island will itself probably in course of time be swept away by the action of the stream, or be converted into a barren mound, resembling the Grand Bar, (last described,) covered with shingle and gravel ; thus has been already formed the sunken neck of land at its lower extremity, called "Dibblee's Bar;" the current having been deflected towards Fraser's Island, has excavated through the soft soil a deep winding channel, which is now generally preferred for the passage of boats, in consequence of having a soft even bottom ; whilst the bed of the old channel, which follows the right bank, is extremely rough and uncertain, as well as being full of sharp projecting points of rock ; this new or left channel has from 10 to 6 feet water through its whole extent, except where it crosses the narrow strip of Dibblee's Bar, where only 2' 9" is found during dry seasons. Complaints are made by Pilots of the very sudden turn in the channel, and of the danger experienced of being carried by the current, before they can bring the boat round, against some large detached masses of rock situate close to the right bank. The two most advanced of them should be removed, and the course of the channel improved by forcing the stream against the west point of Dibblee's Bar, by means of a jettee, a b, 130 yards in length, in order to cut a straighter passage for itself, and which at the same time will have the effect of protecting the foot of the Island, c d, from erosion. The growth of bushes and brushwood should be encouraged as much as possible on the sloping bank of Fraser's Island, to diminish the erosion of the current ; the probable cost of the works proposed will be £135.

BELVISOR'S BAR.—*Survey No. 11.*

The accumulation of ice below Cronkite Island, (where it packs against the left bank,) has caused a deposit of stones, gravel, &c., brought down the stream during the period of the Spring Freshets, and formed a bar from the foot of the Island obliquely across to the right shore, where it spreads into a large bank of shingle, known as "Belvisor's Bar." The water is deep down the branch of the River, on the right of the Island, until the channel, in crossing to the left bank, cuts a passage through the narrow neck of the Bar, where it shoals from 5 feet to 2' 3", but deepens again quickly, giving soundings of 3, 4, 5, and 6 feet within a short space ; a sufficient depth can be obtained in this channel, by stopping the spread of the water over the bar by means of an embankment composed of stones, brush and gravel, extending from the foot of the Island about 500 yards down with the stream ; the danger to be apprehended at this section of the navigation, is that after passing the bar, the current sets directly towards the steep bank on the left, carrying the boat very swiftly towards several large detached

rocks, two of which are situate immediately in its course ; when these are removed, there is a free and deep channel for more than a mile, when a bar formed of stones and coarse gravel, and caused in a similar manner to the one above described, crosses the River near a large cubical rock called the "Governor's Table." The water shoals here to 3' 3" in the average dry seasons, but the bar is not considered at present an obstruction to the navigation ; in the event of the accumulation increasing, a greater force of current should be directed against it, by stopping the flow of water through the masses of rocks found above the Governor's Table, A A A. The probable cost of the dam at foot of Cronkite Island, and the removal of rock, below Belvisor's Bar, will be £250.

MEDUCTIC FALLS.

The rapids known as the "Meductic Falls," are caused by a sudden declivity of the bed of the River, the increased velocity of the stream resulting therefrom, together with the channel being obstructed by large erratic blocks of stone, rendering this part of the navigation extremely precarious. At the head of the rapids the body of water falls towards the left bank, and runs between a number of granite boulders, so distributed, that in order to find a channel at all, it is necessary to follow a very tortuous course ; and the current being exceedingly strong, a boat is liable to be carried against some one of these erratic blocks, in the attempt to avoid striking against another above or below it. Since the judicious removal of several rocks this season by Mr. Ingraham, a boat dropping down the River in the main channel, after passing over the upper bar, finds the first impediment to be a large boulder, No. 1, known to the boatmen as the "Flounces," which forces the boat so far in shore, as to place it in danger of striking against the sunken rocks marked Nos. 2 and 3, whilst endeavouring to regain an eligible position in the stream. Between rocks 4 and 5, for passing clear of the rocks off the projecting point A, towards which they are impelled in consequence of the set of the current being into the small bay above them, we propose to lessen this tendency by endeavouring to deflect the stream off the left bank by the jetty or pier BCD, 110 yards long, built of timber and loaded with stone. Whilst constructing this work, such boulders in its vicinity as impede the passage upwards of towboats, should be removed, and a track made for the horses as near the water's edge as practicable.

The rock No. 1 should be removed before any others are touched ; this effected there will be a comparatively unimpeded channel with deep water the entire way down to the point A ; this however is so contracted between the sunken rocks 4 and 5, that we consider

it of next importance they should be blown up. There are other rocks close to the proposed channel such as those at No. 7, which should be removed, but the exact selection to be made can be decided better after the principal obstructions have been removed, and which should be left to the discretion of the parties performing the work. Until the effect of these works can be observed, it is not advisable to undertake any further improvements. It seems however probable that the construction below the Falls, of a dam projecting from the right bank, would back the water to the foot of the rapid, lessen the force of the current off the point A, and enable a boat to follow a less intricate course among the rocks; the danger however of the passage, can eventually be overcome only by a dam and lock, whenever the increased traffic on the River will warrant the requisite expenditure. The probable cost of these services will be £820, viz. the embankment and blasting rocks.

CALHOUN ROCK.

A number of large rocks are deposited in the River immediately above the Nackawick River, which impede the navigation; 4 of which should be removed, viz:—

One large one near the right bank :

One large one near the left bank :

Two large ones in the centre of the River.

The probable cost will be £15.

KOAC ISLAND.—*Survey No. 13.*

Above the head of Koac Island, the current sets across the River, carrying the ice against the high bank on the right, where it packs, and arresting the transport of the rolling stones, their debris and gravel has raised the bed of the River, forming a narrow bar extending obliquely across it from the right bank to Koac Island, where the depth of water varies from 2' 0" to 2' 6" only. This we propose to improve by reducing the width of the water-way by the dam D C B, constructed from the right bank, and bending 500 yards down the stream; to be formed of sunken cribwork loaded with stone, shingle and gravel; it will average 4 feet in height.

There is a large rock off the projecting point above Koac Island, which impedes the navigation, and should be removed. The probable expense will be £500.

BEAR ISLAND BAR.—*Survey No. 14.*

The "Long Reach" extends from Koac Island to Bear Island, without any interruption, when the water shoals to about 1' 10". To rightly understand this section of the River, it must be regarded

as the basin of one of the chain of Lakes already referred to; in which were deposited at a former period, the alluvial tracks now called "Intervalles," and through which the River is at present cutting a series of passages or channels; thus were formed Long Island, Hog Island, Bear Island, &c., which split the River into several branches creating so great a separation of its waters, that no one branch retains sufficient volume and velocity to convey forward the gravel and sand brought down, which therefore deposit and form bars, raising the bed of the River until the navigation has been obstructed; local circumstances have determined the passage between Bear Island and Hog Island to be the deepest and best channel, and which we propose to improve by conducting more water into it, and confining the stream within narrower limits, where it extends over too large a surface; this can readily be effected in the first place, by closing the passage between Long and Hog Island, by the dam A B, 500 yards long, formed of brush and stone, and covered with shingle and coarse gravel, taking care to make secure abutments: Secondly, by strengthening the existing dam C D, at the foot of Hog Island by a bank of gravel thrown from the stream: Thirdly, by extending the dam down the River to E, for a distance of 670 yards; this latter work to be formed of brush, stone and gravel, and average 5 feet high. The probable cost will be £1,535.

NAPP'S BAR.—*Survey No. 15.*

The still deep water below Wheeler's Island, stops the passage down of the ice, whilst the current pressing (above the head of the Island) from the right to the left bank, continues to force onwards the floating masses until they pack fast against the steep bank of the cove near A B, and ground on the bed of the River; a deposit immediately takes place of stone and gravel, which the stream was conveying down in its course.

This accumulation increasing every year has raised its bed, forming a bar obliquely across its stream. By the nature of the River, the current strives to cross over to the right, but this deposit of gravel changes its course, and forces the water into two channels, which cut through the upper end of the obstruction; the inner one close along the left bank, is that used by boats towing up; but is very crooked and dangerous for steamers, especially in the down passage; the depth on the bar averages from 2 feet to 1' 10". The other channel, after following the middle of the stream, inclines towards the left bank, with soundings passing from 3' 6" to 2' 0", and again rapidly into deep water. The water as above stated having a tendency to fall towards the middle channel, we propose to assist in conducting thither a greater quantity by the dam A B, from the long low Island on the left, crossing the head

of the bar obliquely, and projecting 130 yards down with the stream; whilst the spread of the water may be stopped by the embankment C D projecting from Wheeler's Island 200 yards down the stream, and which from its position will not be liable to be injured by the floods; it will average 3 feet in height. We also propose to stop the discharge by the passage behind Wheeler's Island, by the dam E F.

There are two rocks below the bar and situated in the force of the current, which should be removed. The probable cost of these services will be £670.

BURPY'S BAR.—*Survey No. 16.*

There is a good channel for about 7 miles, the River being confined within its natural limits; about 700 yards above Burpy's Island, the current, after flowing past the point of rock marked A in Plan, instead of being deflected across to the opposite bank, disperses down the stream in nearly equal volumes on each side of Burpy's Bar; that along the left bank can only be used when the water is high, on account of an extensive shoal which crosses it from the foot of the Island; that along the right bank is narrow and deep, and forms the main channel for the passage of boats; its soundings average 6 feet, excepting over a narrow bar of rock and gravel, where only 3 feet is found, also over some isolated projections of rock, which latter can be blown up and removed.

We propose to effect a different division of the waters by projecting past the point where the stream separates into the two channels, a dam formed of cribwork and stone, 320 yards long, obliquely upwards towards the left bank; this work which, during the dry seasons, will confine a greater body of water to the narrow and deep channel, will be no obstruction to the free dispersion of the waters over the larger surface during the period of the Spring Freshets; the bed of the River is composed of rock, (vertical strata,) and covered with large stones from 6" to 12" diameter. The probable cost will be £700.

SPRING HILL.—*Survey.*

The rise and fall of the ocean tide is felt as far as the head of Savage Island, from whence to Spring Hill, a distance of about 1½ miles, the River is divided by a series of Islands, shoals and sandbanks, all of which undergo changes more or less every year, whereby the navigable channels are constantly shifting; what is deep water this year may be a shoal the next. At present the water discharges through three channels; the first, which passes to the right of Hart's Island, is obstructed by two bars, called Russell's and Old Chapel Bar; on the former only 1' 4" is found; the

depth between the bars varies from 6' 0" to 3' 0", and shoals to 1' 2" on the latter, after which soundings from 6 feet to 12 feet extend below Spring Hill. The second or middle channel between Hart's Island and Flat Island, and passing round the foot of Savage Island, is very circuitous and irregular. Boats have only 2 feet water passing Russell's Bar, and 1' 3" over Old Chapel Bar.

The third or Grand Pass, round the head of Savage Island, and between Hart's Island and the left bank of the River, is considerably larger than the other two, but is unobstructed save by a sand bank, at the foot of Flat Island, where the soundings vary from 3' feet to 10".

Before proposing any works for the improvement of the navigation of this locality, or attempting to give the River a fixed regimen, it is requisite to understand the nature and causes of the changes going on from year to year; we conceive that the old course of the stream from Crock's Point to Spring Hill was confined to that portion of the River bed which now constitutes the right channel, and that a tract of flat alluvial land intervened between it and where the Keswick Stream flowed, at the base of the high sloping ground on the left. The water in the River is deep and still to near the head of Hart's Island, and we have been given to understand, freezes over quicker and with stonger ice than it does in the rapid or broken water above; consequently at the first thaw the floating ice accumulates and packs at the head of the Island, backing the water until it overflows all the "intervalles" on the left bank, sometimes to a depth of 16 feet, when the constantly increasing volume of water and masses of ice find vent for themselves by cutting passages through them, an operation much facilitated of late years by the absence of the trees which formerly covered the whole area. These excavations have the local designation of "Thoroughfares." In this way have been formed the numerous tortuous and winding water courses which isolate the parcels of land now called—

Shore's	}	Islands ;
Sugar		
Savage		
Hart's		
Flat		

and judging from the effects produced by the last great freshet on the head of Sugar Island, and from the abrasion being in the direction of the set of the current at high water, it may almost be predicted that at no very distant period a new thoroughfare will be cut through the entire breadth of that Island, in a course which the River is striving to follow.

Simultaneously with these operations, the coarse gravel and boulders brought down by the floods, are deposited at the head of the ice obstruction, and forms the bars which are gradually raising the bed of the old or right channel, and which is now considerably higher than that of one of the thoroughfares at the head of Savage Island, so that a large body of the stream is, during the Summer months, diverted down the latter, and joining with the water of the Keswick River, forms the navigable channel called the Grand Pass, and which we propose to render available for the passage of steam boats at all seasons of the year, in preference to the two other channels.

The first or right channel seems to have been considered as the most eligible one to be made navigable, and considerable labour and expense incurred from time to time by cutting through the extensive deposit of gravel, called the "Old Chapel Bar;" the anticipated advantages of these works are in a great measure lost in consequence of an increased accumulation of gravel on Russel's Bar, immediately above the excavation; at present, and probably for some time to come, the great mass of ice will be drawn down this passage, and grounding, tend to the increase of the bars and shoals which already obstruct the navigation, by causing the deposit of the debris and loose rocks conveyed down by the strong water, so that the boats will always be in danger of receiving injury, should they strike the bottom; the middle channel commencing below Russel's Bar, and being crossed by the continuation of Chapel Bar, presents the same difficulties as the right channel, in addition to being very circuitous; whilst the left or Grand Pass, has one continued and even fall, has a good bed formed of fine gravel and sand, and is free from bars and shoals, excepting a long sand bank at the foot of Flat Island, which can be avoided by taking advantage of a natural canal cut through the extremity of that Island, passing from 3 feet soundings into the deep water opposite Spring Hill. In order to increase the flow of water down the Grand Pass, we propose to throw the jetty No. 1, from the head of Savage Island, 250 yards, obliquely with the stream, protected from the floating ice by a strong pier built of cribwork, loaded with stone, and sheeted with plank; to close the cut through Flat Island by dam No. 2, 300 yards long, and by No. 3, 170 yards long, formed of brush, stone and gravel, 6 feet high, also to divert the water which now passes behind Murray Island, towards the proposed boat channel, by means of dam No. 4, 300 yards long, formed of brush, stone and gravel, 5 feet high. Probable cost £1,670.

The floating ice and high floods being the chief agents of the changes going on every Spring, the permanent success of any proposed work seems problematical, and which may not before many

years be rendered useless in consequence of the deepest discharge of the River being through some other thoroughfare, instead of the Grand Pass as at present. We are extremely diffident when offering any suggestion for the improvement of this section of the River, and in accordance with the suggestions of experienced Engineers who have studied the plans attached to this Report, we strongly recommend that a fresh survey be carefully made the ensuing Summer, of the Islands, bars and shoals, from Crock's Point to Spring Hill, to be compared with the one made last season, and the variations noted which have occurred in the course of the stream in the form and extent of the accumulations, as well as the amount of abrasion which the Islands have suffered by the ice, in order that it may be ascertained how far the existing channels may be depended on, or what future changes may be expected to take place, and thus enable the persons entrusted with the care of the River works, to select and improve the one preferred by nature.

The foregoing considerations, as stated in our preamble, have regard to steam navigation only ; for such improvements as may be required for the more safe and speedy transit of goods by means of tow-boats, consisting chiefly in the removal of isolated erratic blocks, close to the banks of the River, as well as a reconstruction of the tow-path, can be learnt only after a long experience on board the boats, or by a very minute inspection of the course of the stream and its banks, and which services we consider can be best performed, if a special sum be set apart for the purpose, to be applied as may be determined on from time to time, under the superintendence of the professional persons employed to carry out the intentions of the Government.

RESERVOIRS OF SUPPLY.—*Sketch No. 17.*

Your Excellency's instructions further directed an examination of the Lakes at the head of the River, with a view of converting them into "Reservoirs of Supply" for the dry season ; we therefore visited those situate in the Rivers Madawaska, Squattac, Tuladi, Cabineau, Saint Francis, and Baker's Brook ; they receive all the drainage of a tract of country containing about 2000 square miles ; the numerous Lakes studded over this area, are separated from each other by high ridges of uncleared land, confined within their limits by steep sloping banks, favourable to the construction of works for the purpose of damming back the waters. As far as we were able to ascertain by observation, their superficial extent, and the quantity of water which can be held in reserve in them, is as follows, viz :—

	Square Miles.	Cubic Feet.
Lake Temiscuata,	30	8,363,520,000
Lake on Tuladi,	4½	627,264,000
Do. Squattac,	5½	936,594,240
Do. Cabineau,	13	4,349,030,400
Do. Saint Francis,	7½	2,509,056,000
Do. Baker's Brook,	5½	919,987,200
		<u>17,705,451,840</u>

The loss by evaporation consequent on a large surface being exposed to the atmosphere, can be ascertained only after a lengthened series of experiments on the spot, and requires the observer to reside in the neighbourhood of the Lakes for a considerable period. In the absence of such calculations we can only proceed on information derived from other sources, from which we have estimated the probable progressive diminution; we have also made a deduction for filtration and leakage. So that the extra supply will be reduced, after it has been dammed back, as follows, viz:—

RESERVOIRS.	Cubic feet collected.	Cubic feet lost by evaporation.	Cubic feet available.
Lake Temiscuata,	8,363,520,000	31,680,000	8,331,840,000
Lake on Tuladi,	627,264,000	4,662,000	622,602,000
Do. Squattac,	936,594,240	6,216,000	930,378,240
Do. Cabineau,	4,349,030,400	13,468,000	4,335,562,400
Do. St. Francis,	2,509,056,000	12,540,000	2,496,516,000
Do. Baker's Brook,	919,987,200	11,396,000	908,591,200
Total,	17,705,451,840	79,962,000	17,625,489,840

We have assumed that the average cross section of the Saint John River, at mid-summer, measures 2,250 square feet, with a current running at the medium velocity of 20 inches per second; therefore, taking into consideration the increased velocity that would ensue, we compute that these reservoirs, if constructed, would contribute a supply sufficient to increase the depth of water in the River 8 inches during the dry season of 100 days, in the months of July, August, September, and October.

Any increased advantage to be derived from the Tuladi and Squattac Lakes, as feeders to the Saint John River, is dependent on the construction, in the first instance, of a dam to retain the water within the basin of Lake Temiscuata; such work, although of considerable length, would be easy of construction at the outlet of the Lake, where the water is shoal and current sluggish. It

would, at the same time, be very costly, for its erection would necessitate the building of a pair of locks, in order that the traffic, which will undoubtedly be very considerable, and conveyed in tow boats, &c., might not suffer interruption.

Plan No. 17 exhibits the sites which, in our opinion, seem the best for the several dams, the dimensions and probable cost of which, constructed of rough timber, notched and pinned together, and loaded with stone, would be about £14,100, viz:—

	Amount.	Length Feet.	Height
1 Dam at outlet of Lake Temiscuata with locks, waste weir, &c. }	£8,000	575	15
1 Dam — Tuladi, with regulating sluices &c.	1,300	346	16
1 " — Squattac, ditto.	900	300	15
1 " — Cabineau, ditto.	2,400	650	16
1 " — Saint Francis, ditto.	800	200	17
1 " — ditto. ditto.	400	100	17
1 " — Baker's Brook, ditto.	200	80	12
1 " — ditto. ditto.	100	60	10
	£14,100		

"Care Takers" will be requisite, to whom instructions can readily be sent; the head one to act as Lock Master, and reside at the outlet of Lake Temiscuata, with an assistant, to keep the works generally in good order, and visit the dams on the Squattac and Tuladi; a second person residing at the outlet of Glazier Lake, could attend to the dams on the Saint Francis, Cabineau, and Baker's Brooks; existing lumber roads must be cleared of windfalls, and new paths cut to ensure a free communication between the several posts; these contingent expenses would be about

£150 0 0

To which must be added for building houses for the
care takers to reside,

180 0 0

Making a total additional sum of

£330 0 0

It is to be remarked that the concurrence of the Government of the United States must be obtained before attempting to erect dams on the Saint Francis River, as the latter must in part be constructed on their territory; whilst the act of raising the level of the water will drown a portion of their lands bordering on the lakes, on the other hand, the necessity of creating a greater supply of water for boats navigating the Saint John River, may be attributed

in some degree to the reduction of the volume of its tributary, the Alagash, caused by the construction a few years ago of a dam across the bed of the last named River, and sixty miles from the confluence ; whereby the flow of water from the extensive lakes above is diverted from its natural course into one of the branches of the Penobscot.

Before closing our Report, it appears advisable to point out that when improvements are undertaken on a large scale on any of the Rivers at home, it is customary to entrust the supervision of the whole to Special Commissioners, and the execution of the works to one or more professional persons of experience ; we therefore beg leave to suggest, that a similar course be pursued by the Province ; that the parties in question, by giving constant attention to the subject going on, in the position and extent of the shoals and bars, can anticipate any variations in the channel, also order the immediate removal of sunken drift wood and roots of trees, which cause accumulations of debris, gravel and sand. The most fertile source of these deposits, and which should be prohibited, is a custom practised by farmers when clearing land near the banks, of throwing the half burnt trees into the River, to be floated away at high water.

Should our suggestions be approved of, and an attempt made to regulate the River by the construction of artificial dams, jetties, &c., the Province must be prepared for an annual outlay for repairs and improvements to this great highway, and which amount will not probably exceed that usually anticipated for the proper preservation of an equally extensive land route.

In conclusion, we have to observe, that whilst in temperate climates it is practicable by means of artificial works so to regulate a River that it may acquire a fixed regimen, any such result is almost hopeless in British North America ; the floating masses of ice and high freshets, being antagonistic forces much too powerful to contend with ; we are therefore, when endeavouring to obtain a navigable channel, necessitated to conform as much as possible to the natural features of the stream, and improve the passage which discharges the most water during the Summer months ; taking care when contracting it, to avoid creating impediments to the free flow of the water during the freshets, the passage down of the ice and rafts of timber in the Spring. It is at the same time to be observed, no possible care or foresight can provide against the occurrence of occasional contingencies, which can only be averted or ameliorated by attentive observance of the changes whilst in progress.

We have the honour to be Your Excellency's
Most obedient humble servants,

GEO. BENT, *Captain R. E.*
JOHN GRANT, *C. E.*

ABSTRACT.

Place.	Description of Service.	Amount.
WHITE RAPIDS,	1 Dam C D formed of cribwork loaded with stones, shingle and gravel,	£340 0 0
	1 Dam E F do. do.	160 0 0
LITTLE RIVER RAPIDS,	1 Dam formed of sunken cribwork do. do. and blasting 1 rock out of channel.	310 0 0
ARESTOOK BAR,	1 Dam formed of sunken cribwork.	280 0 0
TOBIQUE	1 Dam A B do.	312 0 0
RAPIDS,	1 Dam C D do.	575 0 0
	1 Dam E F do.	443 0 0
TOBIQUE ROCKS,	Removing 1 rock opposite Lally's Creek,	5 0 0
FITZHERBERT'S RAPIDS,	1 Dam do do. and blasting 1 rock out of channel,	250 0 0
CUFFEMAN'S BAR,	1 Dam formed of sunken cribwork,	180 0 0
MONQUART RIVER,	Removing rock from channel,	5 0 0
CHICKTEHAUK STREAM,	Removing 2 do.	10 0 0
GREEN ISLAND,	Dam A B formed of sunken cribwork, &c.,	300 0 0
	Dam C D of stone, brush & gravel,	210 0 0
BECKAGUIMEC,	Dam A B do.	370 0 0
CAMPBELL'S ISLAND,	Removing 5 rocks,	20 0 0
GRAND BAR,	Dam C D of stone, brush & gravel,	460 0 0
	Embankment E F do.	180 0 0
DIBBLEE'S BAR,	1 Dam brush, stone and gravel, and removing 3 rocks,	135 0 0
BELVISOR'S BAR,	1 Dam of stone, brush and gravel, and removing rocks,	250 0 0
MEDUCTIC FALLS,	Embankment C D of cribwork, filled in and backed with stone, and removing rocks,	820 0 0
CALHOUN ROCK	Removing 4 rocks,	15 0 0
KOAC ISLAND,	1 Dam, cribwork loaded with stone,	500 0 0
BEAR ISLAND,	Dam A B, stone, brush & gravel,	465 0 0
	Dam C D strengthened,	30 0 0
	Dam E F, stone, brush & gravel,	1,040 0 0
		£7,655 0 0

ABSTRACT.—*Continued.*

Place.	Description of Service	Amount.
NAPP'S BAR,	Dam A B, cribwork loaded with stone,	£7,665 0 0
	Dam C D and E F, do. do.	220 0 0
	and removing rock,	450 0 0
BURPY'S BAR,	1 Dam, cribwork loaded with stone, and removing rocks,	700 0 0
SPRING HILL,	Jetty No. 1, cribwork loaded with stone, and pier head,	420 0 0
	Jetty No. 2, stone, gravel & brush,	530 0 0
	Jetty No. 3, do.	310 0 0
	Jetty No. 4, do.	410 0 0
		<u>£ 10,705 0 0</u>

GEO. BENT, *Captain R. E.*
JOHN GRANT, *C. E.*

Extracts from Rough Notes relating to the Saint John River,
New Brunswick.

Fredericton, 12th November, 1849.

1. When proceeding up the tributaries of the River Saint John it was always observed, that after poling up any unusual extent of still or dead water, we were certain to come to a "Fall," or to bad rapids.

2. That the effluents were rapid, close to the outlet of every lake, whilst the affluents were generally still at their embouchures.

3. A boulder measuring 6' 0" × 4' 0" × 3' 6" was conveyed by the ice last year, and deposited in the middle of the stream a short distance above the Meductic Falls, or 90 miles below the Grand Falls.

4. A very fertile source of the accumulation of debris, sand and gravel, deposited in this River, is the custom practised by farmers, when clearing land near the bank, of throwing the half burnt trees into the River, to be floated away at high water.

5. From the deep water in the Basin at the foot of the Grand Falls, to Cuffman's Bar, a distance of about 40 miles, the general

characteristic of the River is, that it flows between high sloping banks, and is divided into a series of pools, or reaches, sometimes by natural dams, where ledges of stratified rock extend across the bed of the River; at others its course is blocked up, and the space through which it discharges lessened by numerous reefs and detached masses of rock; and again, by the contraction of the opening between the banks. The pools so formed contain comparatively still, deep water. The rapids occur where the water flows over the top of the natural dams, escapes through narrow passages in these barriers, or discharges in crooked channels between the collection of erratic blocks which obstruct the free flow of the current.

6. A study of the characteristic of the River for 90 miles above Fredericton presents an observer with entirely new features; the banks in many places arising in successive steps, or terraces, from one level surface to another, evince that the bed of the River stood formerly at a much higher level than it does at present; appearances denote elsewhere that the wide basin through which the River flows contained a chain of lakes, which spread through the valley of the Saint John during the period the water stood at a higher level. There is in many localities seen the traces of channels the stream has of late years cut for itself through the alluvial deposit which then took place, (now called "Intervales,") in some places forming Islands, and at others, where the current sets against it, washing it down, until the sunken remains assume the appearance of shoals, or bars, in the course of accumulation.

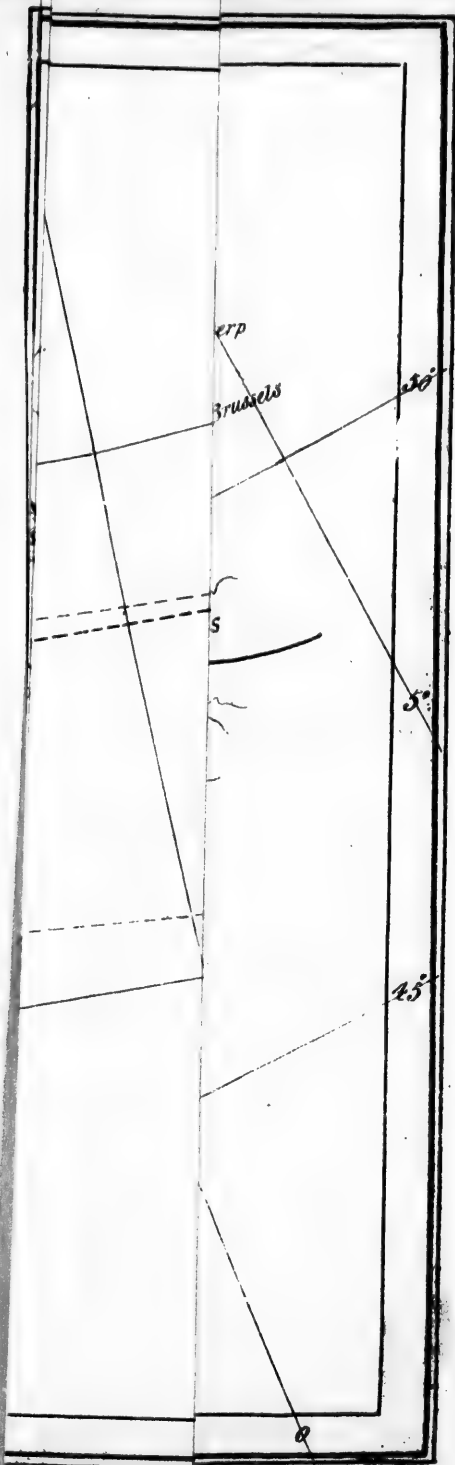
7. The rapids known as the "Meductic Falls," 40 miles above Fredericton, are caused by a sudden declivity of the bed of the River; the increased velocity of the stream resulting therefrom, together with the channel being obstructed by large erratic blocks of stone, renders this part of the navigation extremely precarious.

8. The rise and fall of the ocean tide is felt for 84 miles, namely, as far as the head of Savage Island; from whence to Spring Hill, a distance of about $1\frac{1}{2}$ miles, the River is divided into a series of Islands, shoals and sandbanks, all of which undergo changes more or less every year, whereby the navigable channels are constantly shifting; a passage where deep water is found one year may be shoal the next. At present the stream discharges by three channels; that close to the right bank is conceived to be the old course of the stream, to which it was confined; and that a tract of flat alluvial land, called an Intervale, $1\frac{1}{2}$ miles wide, intervened between it and where the Keswick Stream flowed, at the base of the high and sloping grounds on the left; the water of the River is deep and still to the foot of the Islands, and freezes over quicker and with

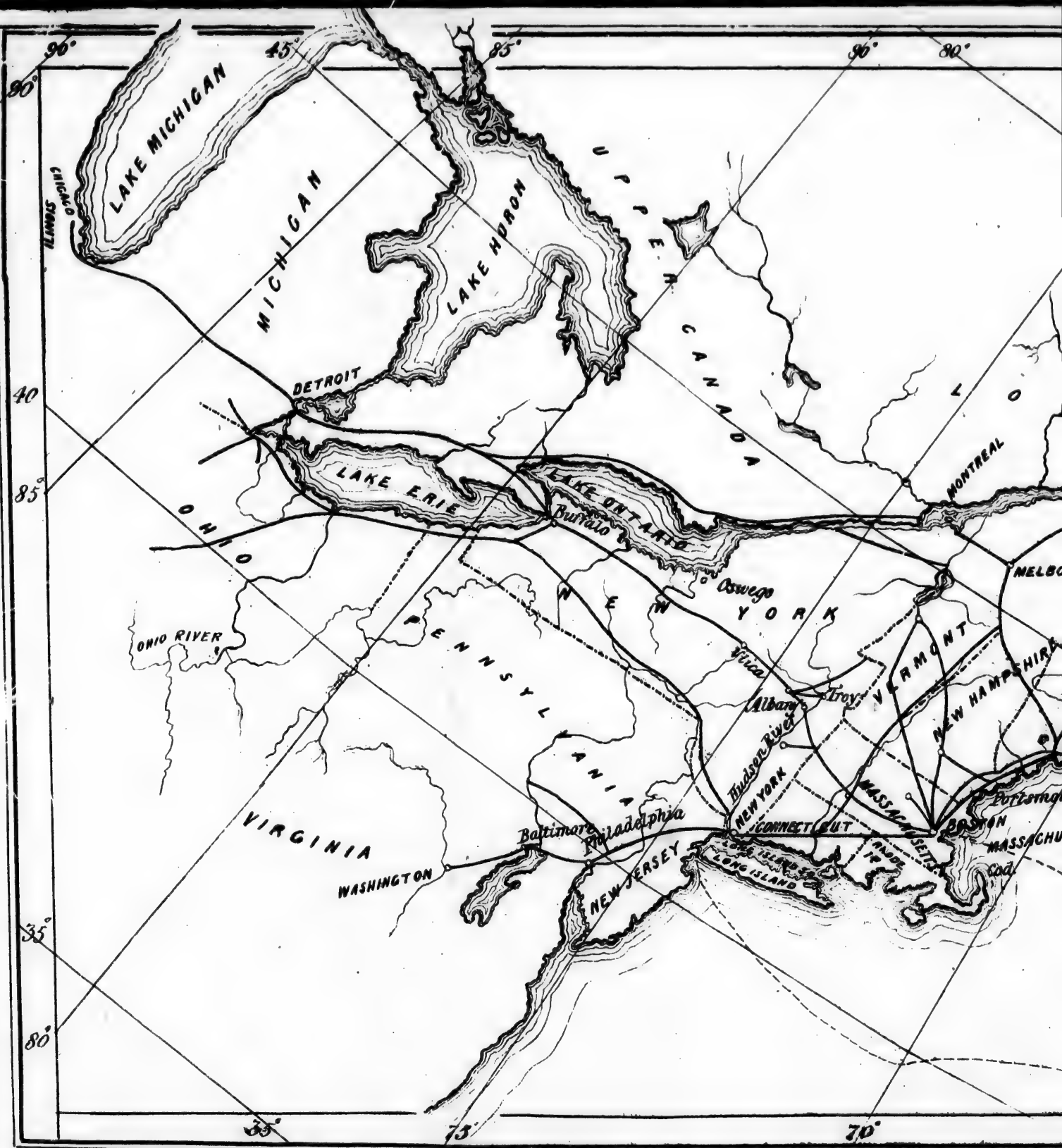
stronger ice than it does in the rapid and broken water above; consequently, at the first thaw the floating ice accumulates and packs at the head of Hart's Island, backing the water until it overflows all the intervalles on the left bank, sometimes to a depth of 16 feet, when the constantly increasing volume of water and masses of ice find vent for themselves by cutting passages through them; an operation much facilitated of late years by the absence of the trees which formerly covered the whole area. These excavations have the local designation of "Thoroughfares." In this way have been formed the numerous winding and tortuous water courses which isolate the parcels of land now called Shore's, Sugar, Savage, Hart's, Flat Islands, &c., and judging by the effects produced by the last great freshet on the head of Sugar Island, also from this abrasion being in the direction of the set of the current at high water, it may almost be predicted that at no very distant period a new Thoroughfare will be cut through the entire breadth of that Island, in a course which the River is striving to follow. Simultaneously with these operations, the coarse gravel and boulders brought down by the floods, are deposited at the head of the ice obstruction, and form bars which are gradually raising the bed of the old or right channel, which is now considerably higher than that of one of the Thoroughfares, so that a large body of the stream is, during the Summer months, diverted down the latter, and joining with the water of the Keswick River, forms the navigable channel called the "Grand Pass."

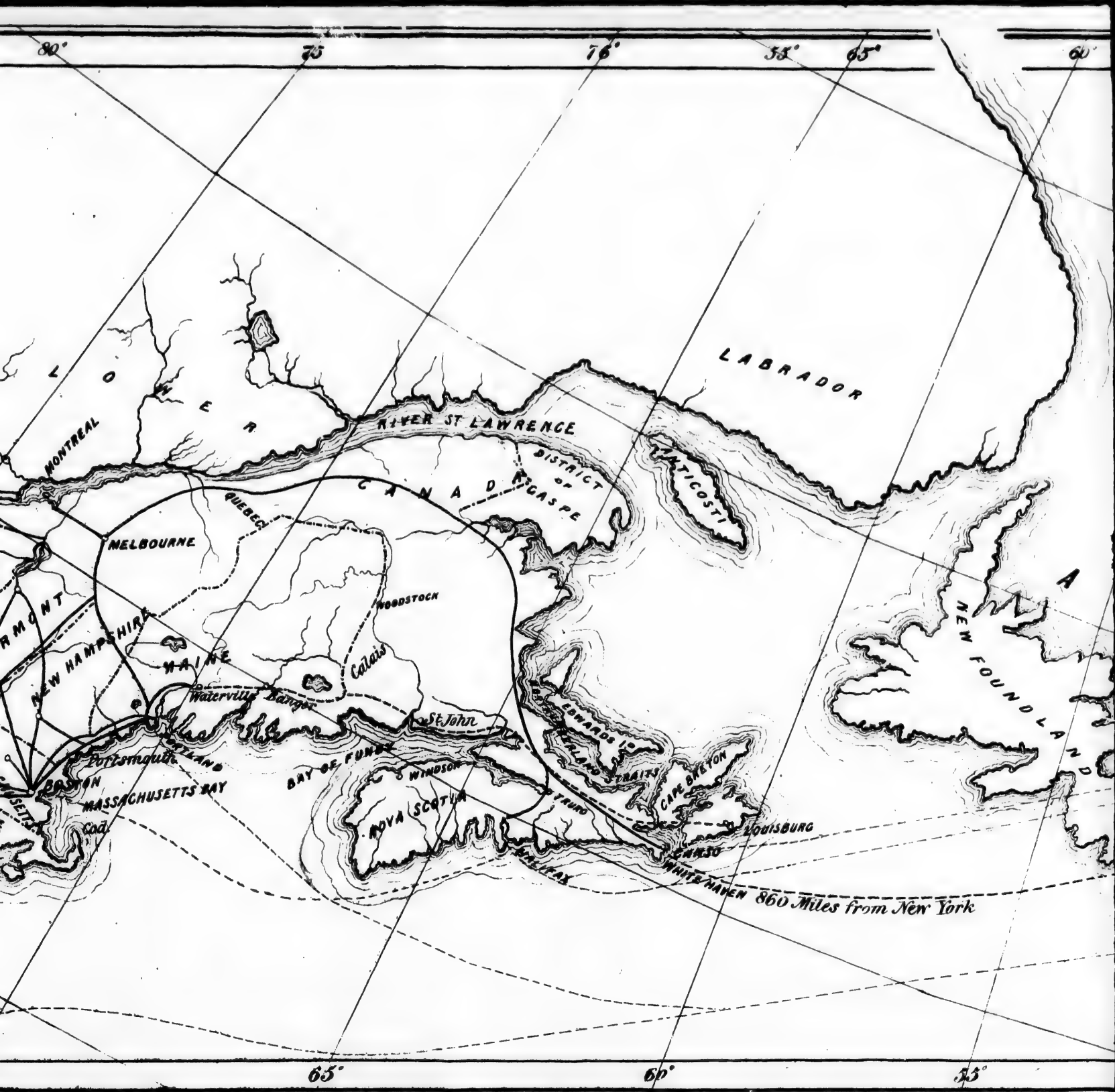
GEO. BENT, *Capt. R. Engineers.*

To His Excellency Sir F^rmund Head, Bart., &c. &c.,
New Brunswick.



J. Eng





MAP

Showing the Plan for Shortening the Time

BETWEEN

NEW YORK AND LONDON.

Drawn by A P Robinson.

W. Leckie, Printer & Stationer, Bolton St.
Allen, litho.

Whitehaven to Galway 2090 Miles.
Boston to Galway 2600 Miles.

Cape Race

40° 35° 30° 25° 20° 15°

The Time of Passage

LONDON.

n.

TOTAL DISTANCE from New York via Whitehaven & Galway to London 3410 Miles.

C

New York to Liverpool 3100 Miles.

O

C

E

A

N

35°

30°

25

20°

15°

10°

SCOTLAND

GALWAY

IRELAND

DUBLIN

Holy Head

LIVERPOOL

ENGLAND

ST. GEORGES CHANNEL

A

N

20°

15°

10°



G. W. Hemans, Esq.